भारतीय मानक
Indian Standard

IS 2461 : 2023

जिमनास्टिक में प्रयुक्त बैलेंस बीम — विशिष्टि

(पहला पुनरीक्षण)

Balance Beam Used In Gymnastics — Specification

(First Revision)

ICS 97.220.30

© BIS 2023

भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
मानक भवन, 9 बहादुर शाह ज़फर मार्ग, नई दिल्ली - 110002
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI - 110002
www.bis.gov.in www.standardsbis.in

February 2023 **Price Group 7**

Sports Goods Sectional Committee, PGD 41

FOREWORD

This Indian Standard (First Revision) has been adopted by the Bureau of Indian Standards after the draft is finalized by the Sports Goods Sectional Committee had been approved by the Production and General Engineering Division Council.

Balancing beams are generally used in women’s artistic gymnastics. The gymnast usually performs on this equipment by mounting the beam either by a vault or a jump and executes various movements.

This standard was first published in 1963, which was based on the draft ISO/R 490 Balancing Beam, and had been prepared by ISO/TC 83 in consultation and collaboration with the International Gymnastic Federation (IGF).

This revision has been brought out to align this with the latest rules and regulations followed by the International Federation of Gymnastics. In this revision, the following significant modifications have been incorporated:

a) Manufacturing and construction requirements have been updated;
b) Performance requirement has been updated; and
c) Functional requirements have been included.

The composition of the Committee, responsible for the formulation of this standard is listed in Annex C.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’.

Indian Standard

BALANCE BEAM USED IN GYMNASTICS — SPECIFICATION

(First Revision)

1 SCOPE

This standard covers the requirements for balancing beams used in gymnastics for women.

2 TERMINOLOGY

2.1 Base Plane — The starting reference plane of the balance beam from which deflection is determined. It is taken as the upper surface of the balance beam loaded by the loading disk prior to any impact.

2.2 Defection (D) — The measured distance (in mm) between the base plane and the bottom surface of the loading disk during the impact.

2.3 Energy of Deflection — The integration value or calculated area under the force-deflection curve expressed in N-m (Newton-meter). The domain of integration is from the rising point to the maximum point of deflection on the curve.

2.4 Force (*F*) — The force applied to the balance beam during the impact, expressed in newton.

2.5 Friction Coefficient of Balance Beam — Quotient of the maximum traction force (in N) and the weight of the slider (in N)

2.6 Intensity of Rebound (DrVr) — The product of rebound deflection and rebound velocity expressed in mm^2/s.

2.7 Loading Disk — The part of the test apparatus which applies the specified load to the test specimen.

2.8 Maximum Deflection (Dmax) — The maximum value of deflection (in mm) measured during the impact.

2.9 Maximum Traction Force — The maximum static friction force (in N), observed at the beginning of the pulling movement of the slider.

2.10 Rebound Deflection (Dr) — The maximum rebounding displacement (in mm) of the bottom surface of the loading disk, measured from the plane of the maximum deflection.

2.11 Rebound Time — The difference in time (s) between the point of maximum deflection and the point of rebound deflection.

2.12 Rebound Velocity (Vr) — The quotient of rebound deflection and rebound time expressed in mm/s.

2.13 Slider — A test body of given mass and geometry for measuring frictional characteristics of the balance beam. The slider includes a test sole which is bonded to the bottom of the slider and made of synthetic material with defined friction properties.

3 CONSTRUCTION AND WORKMANSHIP

3.1. Balancing beam consists a beam held by a base consisting of two supports. The beam shall be straight, upper surface and axis shall be even and horizontal. The base design is not prescribed. However, its legs may not protrude beyond the projection of the beam in its longitudinal direction.

3.2 The supports shall be cushioned and shall not increase beyond the vertical projection of the beam.

The front part of the beam shall be cushioned by rounded, damping padding. The thickness of the cushioning of the front part of the beam shall not be less than 15 mm and more than 30 mm. The padding shall reach the top edge of the beam, however, the radius of the rounding must begin immediately at the end of the beam so that the padding will not increase the total length of the beam.

3.3 The shape and dimensions of the balance beam shall be as given in Fig. 1. Where they are not specified, they are left to the discretion of the purchaser and supplier.

3.4 The height of the beam shall be adjustable. It can be continuous or in 50 mm increments. Adjusting the device for the height shall be so constructed that the performance of the fixture shall not diminish during use.

3.5 The arrangement of the fixed feet and adjustable leg shall be such as to ensure stability on uneven ground. The feet shall be provided with rubber shoes to reduce the possibility of sliding along the floor.

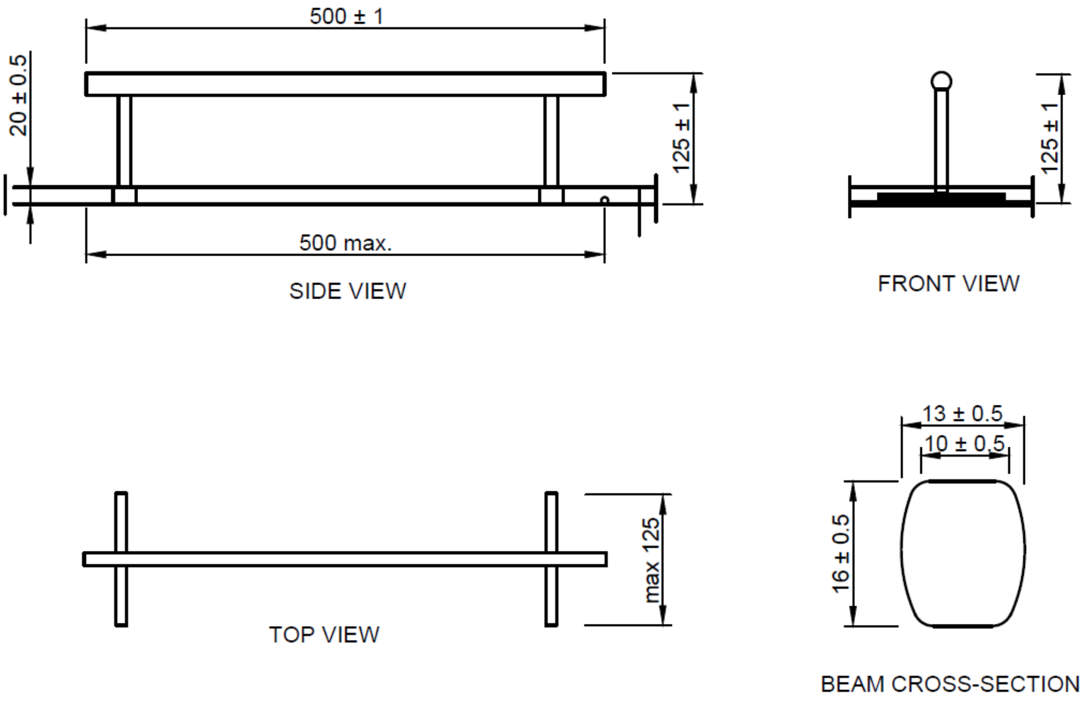
4 REQUIREMENTS

4.1 Material

4.1.1 The walking surface of the beam shall be made of a suitable good quality, well-seasoned wood which shall not splinter easily. The recommended species of timber are:

Trade Name	*Botanical Name*
babul	*Acacia arabica*
benteak	*Lagerstromia lanceolara*
sandan	*Ougeinia dalbergioides*
bijasal	*Pterocarpus mprsupium*
sal	*Shorea tobusta*
dhaman	*Grewia tilicefolia*
laurel	*Terminalia tomentosa*
axlewood	*Anogeissus latifolia*

4.1.2 The supports may be made of either steel or cast iron.



(All dimensions are in centimeters)

FIG. 1 SHAPE AND DIMENSION OF BALANCE BEAM

4.2 Functional Requirements

4.2.1 The surface of the balancing beam shall have impact absorbent characteristics to protect the gymnast's joints and limbs. It shall also have elasticity to support the jumps. It shall be step safe and elasticity shall be equally distributed.

4.2.2. The upper surface material of the balancing shall not be slippery. The cover material shall not produce skin burns. The upper edge of the padding at the front parts of the beam shall not be harder than the surface of the beam.

4.2.3 All protruding parts, like screws underneath the balance beam shall be cushioned or hidden.

4.2.4 The balancing beam shall not vibrate in its supports during use.

5 PERFORMANCE TESTS REQUIREMENTS

5.1 Elasticity and Shock Absorption

When tested according to the procedures described in **A-3**, the values of the measured variables shall be as given in Table 1.

Table 1 Requirements for Test A – Elasticity and Shock Absorption of Balance Beams
(*Clause* 5.1)

Sl No.	Elasticity and Shock Absorption of Balance Beam	D_{max} mm	E N-m	D_r mm	D_rV_r mm^2/s
(1)	(2)	(3)	(4)	(5)	(6)
(i)	Mean value across impact sites 1 to 7	$3.5 \leq x \leq 14.0$	$2.5 \leq x \leq 9.5$	$3.0 \leq x \leq 20.0$	$300 \leq x \leq 4800$
(ii)	Difference between highest and lowest mean value on impact sites 1 to 7	≤ 5.0	≤ 3.0	≤ 5.0	≤ 2400

NOTE — 'x' represents the mean values of the measured variables

5.2 Top Friction

When tested according to the procedures described in **B-3**, the mean values of the measured variables shall be as given in Table 2.

Table 2 Requirements for Test B – Top Friction of Balance Beam
(*Clause* 5.2 *and* B-3)

Sl No.	Top Friction of Balance Beam	Friction Coefficient of Balance Beam
(1)	(2)	(3)
(i)	Mean value across test sites	$0.35 \leq x \leq 0.60$
(ii)	Difference between highest and lowest mean value on test	≤ 0.05
(iii)	Difference between mean values of orthogonal test	≤ 0.05

NOTE — 'x' represents the mean values of the measured variables

6 PACKING AND MARKING

6.1 Packing

The balance beam shall be packed as agreed to between the purchaser and the supplier.

6.2 Marking

6.2.1 The balancing beam shall be marked with the followings:

a) Manufacturer’s name and trade-mark; and
b) Month and year of manufacture.

6.2.2 *BIS Certification Marking*

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations framed thereunder, and the product(s) may be marked with the standard mark.

ANNEX A
(*Clause* 5.1)

ELASTICITY AND SHOCK ABSORPTION TEST

A-1 TEST SPECIMEN

The test specimen submitted for testing shall consist of a complete balance beam as it is intended to be used during training and/or competition.

A-2 TEST APPARATUS

A-2.1 Impact Test Machine

Any type of dynamic testing apparatus that is capable of impacting a test specimen using the prescribed loading condition and monitoring and recording the force-time history and deflection-time history of the loading disk is acceptable. The impact test machine shall have sufficient rigidity to eliminate undesirable vibrations in the apparatus which might be recorded on the force-time curve and deflection-time curve. The impact test machine shall also be designed in such a manner that only the bottom surface of the loading disk contacts the test specimen at any time during the test procedures.

A-2.2 Loading System

The loading system of the impact test machine shall meet the following requirements (*see* Fig. 2).

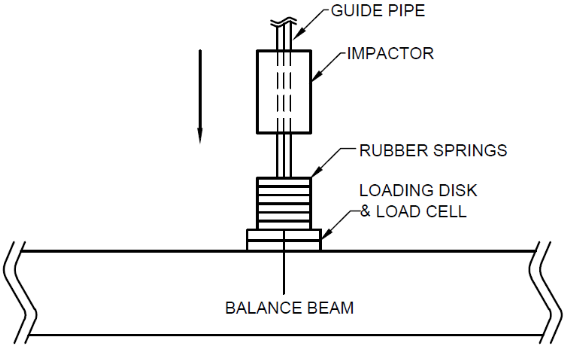


FIG 2: SETUP OF THE LOADING SYSTEM

A-2.2.1 *Characteristics of the Dynamic Load*

The maximum dynamic force shall be 130 0 N ± 26 N when this loading system is applied to the testing anvil. The time from the onset of force application to the time of maximum force shall be 50 ms ± 2 ms.

A-2.2.2 *Impactor*

The dropping impactor shall be 15 kg ± 0.1 kg and shall have a flat impact face. The impactor shall have the shape of a thick cylinder and shall be dropped along a guide pipe. The decision of the size of outside and inside diameters of the impactor is at the discretion of the test laboratory, but the clearance between the inside hole of the impactor and the guide pipe shall be 2 mm ± 0.2 mm. The dropping height of the impactor shall be 120 mm ± 1 mm to the upper surface of the rubber springs.

A-2.2.3 *Release Mechanism*

The release mechanism shall be unattached to the loading disk and the guide pipe to prevent an additional load with the attached impactor on the loading disc and the test specimen before the impact.

A-2.2.4 *Loading Disk and Guide Pipe*

The loading disk shall have a diameter of 70 mm ± 0.5 mm. Total mass of the loading disk including the force transducer and the guide pipe shall be 5 kg ± 0.2 kg.

A-2.2.5 *Rubber Springs*

A set of rubber springs shall be selected to meet the requirements described in **A.2.2.1**.

A-2.3 Recording Equipment

The recording equipment shall meet the following criteria:

A-2.3.1 *Force – Time*

The selection of the specific force-time recording equipment, including transducers and recorders, is at the discretion of the test laboratory. However, the recording system shall have a frequency response adequate to measure the peak force value to an accuracy of ± 3 percent of the true value. The total system, detection, and recording, shall be capable of measuring impact forces of up to 2 000 N at frequencies from 2 Hz to 1 000 Hz to an accuracy of ± 3 percent. The minimum sampling rate of the data acquisition system shall be 5 000 Hz.

A-2.3.2 *Displacement – Time*

The selection of the specific displacement - time recording equipment, including transducers and recorders, is at the discretion of the test laboratory. However, the recording system shall have a frequency response adequate to measure the dynamic displacement value to an accuracy of ± 3 percent of the true value. The total system, detection and recording, shall be capable of measuring the displacement of ± 50 mm at frequencies from 2 Hz to 1 000 Hz to an accuracy of ± 3 percent. The minimum sampling rate of the data acquisition system shall be 5 000 Hz.

A-2.3.3 *Filtering*

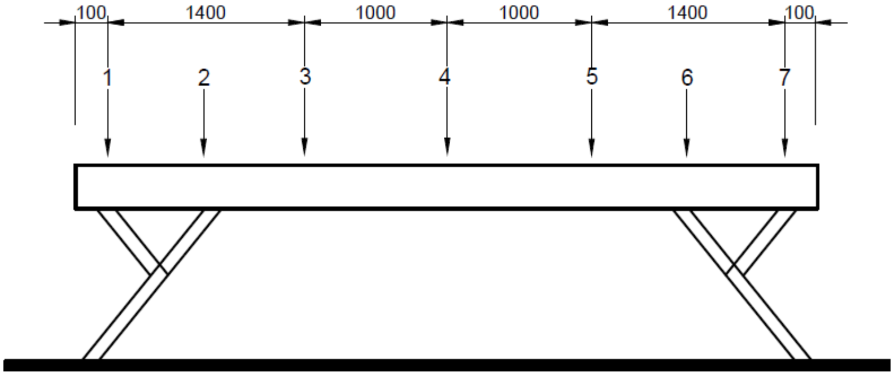
The signal from all transducers shall be conditioned with a low pass filter which complies with channel class 1 000 of SAE recommended practice J211. A fourth-order butterworth low pass filter with a cut-off frequency of 1 000 Hz meets this requirement.

A-3 TEST PROCEDURE

A specimen balance beam is impacted by dropping an impactor from a predetermined height onto a set of rubber springs and a loading disk which are located on the top surface of the test specimen prior to the impact. Transducers mounted in the loading disk shall monitor the force – time history and displacement – time history of the loading disk. This data shall be recorded with the aid of a data acquisition system.

A-3.1 Impact Sites

A total of seven impact sites shall be designated on the test specimen (*see* Fig. 3) for an illustration of the impact sites.



2 , 6 : INTERSECTIONS OF BEAM AND LEGS

(All dimensions in millimeters)

FIG.3 IMPACT SITES ON THE BALANCE BEAM

A-3.2 Impact Test Procedures

A-3.2.1 Place the test specimen under the impact test machine on a smooth, solid, and horizontal floor (concrete or metal plate) and orient the loading disk such that the center of the loading disk contacts one of the designated impact test sites.

A-3.2.2 Raise the impactor to an appropriate drop height such that it will impact the rubber springs and generate the proper dynamic load described as given in **A-2.2**.

A-3.2.3 Release the impactor and capture the force-time history and displacement - time history using the recording equipment described in section **A-2.3**.

A-3.2.4 Upon completion of a given impact test, raise the impactor off the loading disk.

A-3.2.5 The duration between tests at a given impact site shall not be less than 120 seconds.

A-3.2.6 Impact each of the seven impact sites five times. Each test specimen shall receive a total of 35 impacts.

A-4 CALCULATIONS

A-4.1 Immediately following each test, record the following measurements: D_{max} (mm), E (Nm), Dr (mm) and D_rV_r (mm^2/s).

A.4.2 Determine the arithmetic mean values of the measured variables for each impact site and for the overall mean values of the measured variables across all impact sites. Determine also the differences between the highest and lowest mean values of the measured variables for each test site and across all test sites.

ANNEX B

(*Clause* 5.2)

TOP FRICTION TEST

B-1 TEST SPECIMEN

The test specimen submitted for testing shall consist of a complete balance beam as it is intended to be used during training and/or competition.

B-2 TEST APPARATUS

B-2.1 Measurement Device

Any type of friction testing apparatus that is capable of pulling a slider on the surface of a specimen balance beam at the required test velocity is acceptable. During the test, the traction force-time history of the slider shall be monitored and recorded.

B-2.2 Slider

The slider shall have a mass of 5 kg ± 0.2 kg. A square-shaped test sole with a thickness of 10 mm ± 0.5 mm and a size of 40 mm ± 1 mm shall be bonded to the bottom of the slider. The thickness of the test sole shall be decreased to 75 percent ± 5 percent of the original thickness at a pressure of 5 N/cm^2. The coefficient of static friction of the test sole shall be 0.25 ± 0.03. The slider shall be pulled at a constant loading rate of 5 N/s ± 0.5 N/s.

B-2.3 Recording Equipment

The recording equipment shall meet the following criteria:

B-2.3.1 *Force – Time*

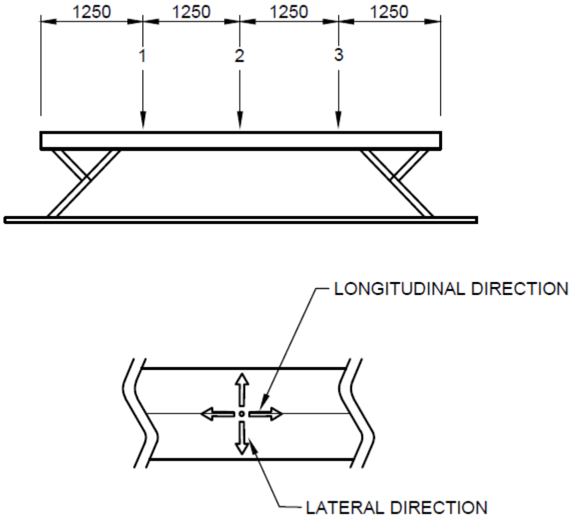
The selection of the specific force-time recording equipment, including transducer and recorder, is at the discretion of the test laboratory. The total system, detection, and recording, shall be capable of measuring traction forces up to 100 N at frequencies from 2 Hz to 100 Hz to an accuracy of ± 3 percent. The minimum sampling rate of the data acquisition system shall be 200 Hz.

B-3 TEST PROCEDURE

A slider is pulled horizontally upon the surface of a specimen balance beam at a defined loading rate. A transducer connected to the pulling string shall monitor the maximum traction force generated during the pulling movement.

When tested according to the procedures described in **B-3**, the mean values of the measured variables shall be within the figures in Table 2.

B-3.1 Test Sites and Directions
A total of three test sites shall be designated on the test specimen as illustrated in Fig. 4. Four orthogonal test directions for the traction of the slider shall be also designated on each test site as illustrated in Fig. 4.



(All dimensions are in millimetre)

FIG 4: TOP FRICTION TEST SITES AND DIRECTION ON THE BALANCE BEAM

B-3.2. Friction Test Procedures

B-3.2.1 Place the complete test specimen on a smooth, solid and horizontal floor.

B-3.2.2 Place the slider on the test specimen in such a manner that the centre of its sole will contact one of the designated test sites, and also in such a manner that the pulling direction of the slider will conform to one of the designated test directions. Just before putting the slider on the test specimen, magnesium carbonate powder of 1g shall be spread on the surface of the test site each time.

B-3.2.3 Pull the slider horizontally at a constant loading rate of 5 N/s ± 0.5 N/s and record the traction force – time history using recording equipment described in Section **B-2.3**

B-3.2.4 Repeat the procedure given in **B-3.2.2** and **B-3.2.3** five times at each test site and in each test direction.

B-3.2.5 Each test specimen shall receive a total of 60 friction test procedures.

B-4 CALCULATIONS

B-4.1 Immediately following each test, record the friction coefficient.

B-4.2 Determine the overall mean value of the friction coefficient across the test sites 1 to 3. Determine also the difference between the highest and the lowest mean value of the friction coefficient between all test sites, and the difference between the mean values of the friction coefficients of the orthogonal test directions between all test sites.

ANNEX C

(*Foreword*)

COMMITTEE COMPOSITION

Organization	*Representative(s)*
Sports Goods Export Promotion Council	SHRI TARUN DEWAN (***Chairperson***)
All India Lawn Tennis Association, New Delhi	SHRI NAR SINGH
Anand & Anand	SHRI ASHISH ANAND
Athletic Federation of India	SHRI SANDEEP MEHTA SHRI GOPALA KRISHNAN (*Alternate*)
Central Institute of Plastics Engineering & Technology (CIPET), Murthal	DR S. N. YADAV
COSCO India Pvt Ltd, Gurgaon	SHRI PANKAJ JAIN SHRI NARINDER JAIN (*Alternate*)
Director Equipment Sports Authority of India, New Delhi	SHRI ROQUE DIAS
Freewill Sports Pvt Ltd, Jalandhar	SHRI RAJESH KHARBANDA
Government e Market Place, New Delhi	SHRI N. K. MALHOTRA
Gymnastic Federation of India, Mumbai	SHRI RIAZ BHATI
Hockey India	COMMANDER R. K. SRIVASTAVA
Micro, Small and Medium Enterprises, Technology Development Centre, New Delhi	SHRI V. K. SINGH
NELCO (India) Pvt Ltd, Meerut	SHRI AMBER ANAND
Office of Development Commissioner (MSME), Delhi	SHRI SUNIL GUPTA
Premier Enterprises, Meerut	SHRI SUMESH AGARWAL SHRI KSHITIJ AGARWAL (*Alternate*)
Process Cum Product Development Centre, Meerut	SHRI SUNIL GUPTA
Ranson Sports Industry, Jalandhar	SHRI ARVIND SINGH RANA
Sanspareils Greenlands Pvt Ltd, Meerut	SHRI PUNEET ANAND ALOK MISHRA (*Alternate*)
Shri Ram Institute For Industrial Research, Delhi	DR VINAY TYAGI
Soccer International Pvt Ltd, Jalandhar	MS SHAALINI GUPTA
Softball Association of India	MS SHIBANI TAGORE

Sports Goods Manufacturers and Exporters Association (SGMEA), Jalandhar	Ms Harshita
Sports Line, New Delhi	Shri Ojasvi Nagpal
Stag International Sports, Meerut	Shri Rakesh Kohli Shri Vivek Kohli (*Alternate*)
Universal Sports, Jalandhar	Shri Mahesh Chadha
Vats Sports, Meerut	Shri Lokesh Vats
Voluntary Organisation In Interest Of Consumer Education (Voice), New Delhi	Shri M. A. U. Khan
BIS Directorate General	Shri R. R. Singh, Scientist 'E'/Director and Head (Production and General Engineering) [Representing Director General (*Ex-officio*)]

Member Secretary
Shri Ajay Kumar
Scientist 'B'/Assistant Director
(Production and General Engineering), BIS

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act*, 2016 to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Copyright

BIS has the copyright of all its publications. No part of these publications may be reproduced in any form without the prior permission in writing of BIS. This does not preclude the free use, in the course of implementing the standard, of necessary details, such as symbols and sizes, type or grade designations. Enquiries relating to copyright be addressed to the Head (Publication & Sales), BIS.

Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the website-www.bis.gov.in or www.standardsbis.

This Indian Standard has been developed from Doc No.: PGD 41 (18479).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones: 2323 0131, 2323 3375, 2323 9402 *Website*: www.bis.gov.in

Regional Offices: *Telephones*

Central : 601/A, Konnectus Tower -1, 6th Floor,
DMRC Building, Bhavbhuti Marg, New
Delhi 110002 — 2323 7617

Eastern : 8th Floor, Plot No 7/7 & 7/8, CP Block, Sector V,
Salt Lake, Kolkata, West Bengal 700091 — 2367 0012, 2320 9474

Northern : Plot No. 4-A, Sector 27-B, Madhya Marg,
Chandigarh 160019 — 265 9930

Southern : C.I.T. Campus, IV Cross Road, Taramani, Chennai 600113 — 2254 1442, 2254 1216

Western : Plot No. E-9, Road No.-8, MIDC, Andheri
(East), Mumbai 400093 — 2821 8093

Branches : AHMEDABAD. BENGALURU. BHOPAL. BHUBANESHWAR. CHANDIGARH. CHENNAI. COIMBATORE. DEHRADUN. DELHI. FARIDABAD. GHAZIABAD. GUWAHATI. HIMACHAL PRADESH. HUBLI. HYDERABAD. JAIPUR. JAMMU & KASHMIR. JAMSHEDPUR. KOCHI. KOLKATA. LUCKNOW. MADURAI. MUMBAI. NAGPUR. NOIDA. PANIPAT. PATNA. PUNE. RAIPUR. RAJKOT. SURAT. VISAKHAPATNAM.

Published by BIS, New Delhi